Small Business Innovation Research/Small Business Tech Transfer

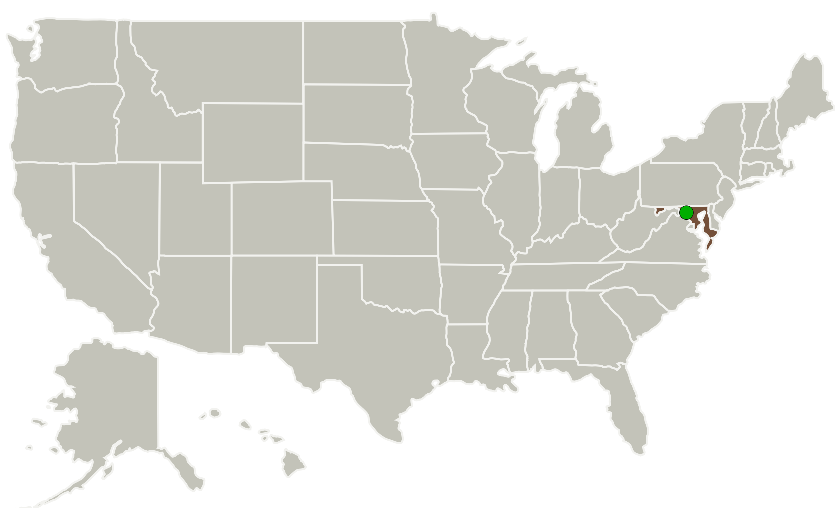
Novel Silicon Carbide Deep Ultraviolet Detectors: Device Modeling, Characterization, Design and Prototyping, Phase II

Completed Technology Project (2012 - 2014)

Project Introduction

Silicon Carbide deep UV detectors can achieve large gains, high signal-to-noise ratios and solar-blind operation, with added benefits of smaller sizes, lower operating voltages, radiation hardness, ruggedness and scalability. SiC UV APDs implementation is challenging due to some material defects, relatively not-well modeled device operation, and very high absorption coefficients near 200nm wavelengths. The objective of this proposed work is to extend the state-of-the-art in UV sensors by: a) developing SiC deep UV detectors, and b) improving their responsivity down to near 200nm wavelengths. We plan to accomplish this goal by using the SiC UV APD design simulator developed in Phase I, and making further improvements as we introduce new design concepts to improve the responsivity utilizing novel design and fabrication techniques tof the critical n+ top contact layer on the APD to reduce charge recombination in the UV absorption layer. We will develop unique fabrication techniques to improve surface quality of the SiC APD structure. This effort will be led by Auburn University, which has developed state-of-the-art fabrication methodologies and capabilities for SiC MOSFETs, in collaboration with CoolCAD who will design the devices and the implantation process. Our main effort will focus on generating a built-in surface field by creating a steep doping profile right at the surface. Since steep dopant gradients necessary to create a field within 40nm of the surface are not feasible using epitaxial growth techniques for SiC, we will develop implantation and dopant activation sequences, and backend processing techniques to achieve this goal. By creating a field in the deep UV absorption layer (~40nm), we will reduce the initial recombination of electron-hole pairs created by the UV photons and increase current reaching the multiplication region of the APD.

Primary U.S. Work Locations and Key Partners



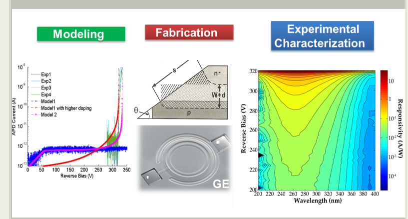


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Table of Contents

Novel Silicon Carbide Deep Ultraviolet Detectors: Device Modeling, Characterization, Design and Prototyping, Phase II

Completed Technology Project (2012 - 2014)

Organizations Performing Work	Role	Type	Location
CoolCAD Electronics, LLC	Lead Organization	Industry	Takoma Park, Maryland
Goddard Space Flight Center(GSFC)	Supporting Organization	NASA Center	Greenbelt, Maryland

Primary U.S. Work Locations
Maryland

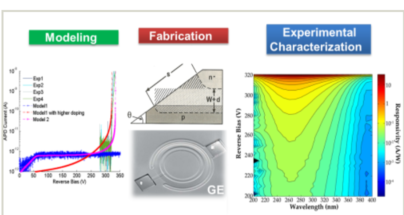
Project Transitions

April 2012: Project Start

September 2014: Closed out

Closeout Documentation:
- Final Summary Chart*(https://techport.nasa.gov/file/138380)*

Images



Project Image
Novel Silicon Carbide Deep Ultraviolet Detectors: Device Modeling, Characterization, Design and Prototyping
(https://techport.nasa.gov/image/128103)

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

CoolCAD Electronics, LLC

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

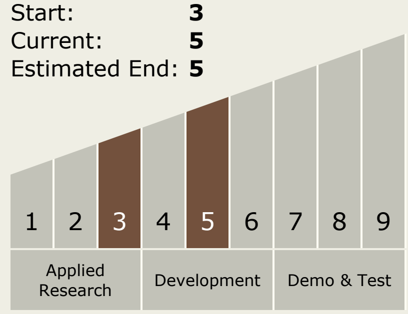
Carlos Torrez

Principal Investigator:

Akin Akturk

Technology Maturity (TRL)

Start: **3**
Current: **5**
Estimated End: **5**



Technology Areas

Primary:

- TX08 Sensors and Instruments
  └ TX08.1 Remote Sensing Instruments/Sensors
    └ TX08.1.1 Detectors and Focal Planes

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System